Synopsis

Ph.D. in Education

Effect of Tech Aided Grade2 (TAG2B) Braille Tutoring System for Students with Visual Impairment

Investigator

R.Vaijayanthi

Reg No: 17PHEDP002

Supervisor

Dr.G.Victoria Naomi

Professor & HOD

Department of Special Education

Submitted to

Avinashilingam Institute for Home Science and Higher Education for Women

Coimbatore

August 2021

I. INTRODUCTION

On January 4th we celebrate World Braille Day and the huge impact that Louis Braille's invention has had on the lives of the visually impaired people all over the world. Braille always has been and always will be more than just a tool for visually impaired individuals. Braille represents competency, independency and equality. Braille is not a code to be deciphered but is a method of reading and writing that is equal in value to print for sighted people. A lot has changed both in technology and educational practices since Braille was invented in 200 years ago. Nowadays students have access to different kinds of technology based devices and computers. However the fundamental importance of Braille remains unchanged and as important as ever. There is a real concern in the blind community that there is less support for teaching, using and investing in Braille particularly among educators and governments. The advances in technology is booming but the technology should be used to enhance skills. For this reason, a Tech Aided Braille tutoring system has been developed in the study for Grade2 Braille.

II. REVIEW OF LITERATURE

Shahbaz Ali Khidri and etal in his article on "**Blind Aid: A Self-Learning Braille System for Visually Impaired**" developed the design of a low-cost, low-power, portable, self-learning, and user friendly Braille system. The designed system serves as Braille writing and reading tutor, so visually impaired people can enhance their Braille writing and reading skills without the assistance of a Braille teacher. By implementing the designed Braille system in schools and homes, Braille literacy rate can be increased and visually impaired people can be employed and can fully participate in society.

Gustavo Caiza et al in his article **Braille Grade 1 Learning and Monitoring system** explained the implementation of a low-cost prototype for reading, writing, and audio-assisted evaluation. This didactic and user-friendly system aims to improve the learning of disabled people by providing teachers new and modern alternatives to lead and monitor the student's activities. For designing the prototype, the researchers followed the suggestions provided by teachers of the "Mariana de Jesus" institute for blind and deaf children. The implementation was carried out using a Raspberry Pi 3B board due to its high performance and low cost. The device improves and eases learning of Braille grade 1, allowing the monitoring of the progress reached, with and an acceptance of 91% obtained from the teachers of the institute.

Peaco and Freddie L., Comp. in his reference circular on "**Braille Literacy: Resources for Instruction, Writing Equipment, and Supplies. NLS Reference Circular"** lists instructional materials, supplies, and equipment currently available for learning braille, and cites sources about braille literacy. The resources given are intended to assist sighted individuals who are interested in learning braille or want to transcribe print materials into braille; instructors who teach braille; persons with visual impairments who are interested in learning to read and write braille; and family members, friends, and professionals who desire information about braille literacy.

III. RATIONALE FOR THE STUDY

Though it is known that teachers are trained to teach pupils in schools and conduct lessons every day, teaching pupils with visual impairment constitutes a challenge for teachers (Simalalo, 2006). Pupils with visual impairment require alternative forms of teaching and learning methods. This includes the use of Braille to read and write and other assistive devices that increase accessibility to education. One of the most important skills when learning Braille is that it is such a unique skill to have. But this skill is really hard to find nowadays. The World Blind Union strongly recommends that all blind and severely partially- sighted children be given the opportunity to learn and become proficient in Braille reading and writing skills and they receive instruction from those who are thoroughly trained and qualified to teach Braille. Braille can be written using individual letters of the alphabet, and this is known as Grade 1 or uncontracted Braille. It can also be written using contractions or Grade2 Braille. It is quick, simple and can be faster to read than grade 1 Braille. Unlike the eyes, the fingers cannot be taught to take in a whole line at a glance. The information is put into smaller packages. If the child can run her fingers over the letter c and read the word "can," or the letter l and read the word "like," she can, in a sense, absorb information at a tactile glance. Reading a whole-word contraction is quicker than having to read "c-a-n" or "l-i-k-e. Contractions save time and space because Braille is big and takes up more space than standard print. Contractions also make reading and writing Braille much faster. Most braille, like books, signs in public places, menus, and most other braille materials, are done in Grade2. Heather Field (2012) recommended teaching contracted Braille from the start. The amount a child can read is limited to the number of actual dots he/she can get under the fingertips at a given time.

Considering the present context, a survey of literature related to technology aided Grade2 Braille was explored in Indian context. It focussed to find a self-learning tool for Braille. Hence an attempt was made to develop technology based Grade2 Braille Tutoring System which intended to provide three modes viz., Learning Mode, Practice Mode and Evaluation Mode. The newly developed tech aided system is for independent use for visually impaired persons and teachers and anyone interested to learn Braille.

1V.STATEMENT OF THE PROBLEM

The statement of the problem is worded as **"Effect of Tech Aided Grade2 Braille Tutoring System for Students with Visual Impairment"**

V. OBJECTIVES OF THE STUDY

The objectives of the study were to:

1. Develop Tech Aided Grade2 Braille Tutoring System to enhance Braille literacy of students with visual impairment.
2. Study the effect of Tech Aided Grade2 Braille Tutoring System by introducing it to the students with visual impairment.
3. Compare the test mean scores of Grade2 Braille obtained by the Students with visual impairment before and after introduction of Tech Aided Grade2 Braille Tutoring System.

4. Rate the effectiveness of the Tech Aided Grade2 Braille Tutoring System by introducing it to the In-service and Pre-service teachers.
5. Study the influence of Gender on learning of Grade2 Braille Tech Aided Tutoring System.
6. Study the influence of Grade on learning of Grade2 Braille with Tech Aided Tutoring System.

VI. HYPOTHESES

The null hypotheses selected for the study:

1. There is no significant difference in the mean scores of Grade2 Braille obtained by the students with Visual Impairment before and after introduction of Tech Aided Grade2 Braille Tutoring System.
2. There is no significant difference in the mean scores of Alphabet Word Sign before and after introduction of Tech Aided Grade2 Braille Tutoring System
3. There is no significant difference in the mean scores of Strong Words before and after introduction of Tech Aided Grade2 Braille Tutoring System
4. There is no significant difference in the mean scores of Lower Signs before and after introduction of Tech Aided Grade2 Braille Tutoring System
5. There is no significant difference in the mean scores of Dot-5 Initial Letter before and after introduction of Tech Aided Grade2 Braille Tutoring System
6. There is no significant difference in the mean scores of Dot 4,5 Initial Letter before and after introduction of Tech Aided Grade2 Braille Tutoring System
7. There is no significant in the mean scores of Dot 4,5,6 Initial Letter before and after introduction of Tech Aided Grade2 Braille Tutoring System
8. There is no significant difference in the mean scores of Final Letter before and after introduction of Tech Aided Grade2 Braille Tutoring System
9. There is no significant difference in the mean scores of Short Form Words before and after introduction of Tech Aided Grade2 Braille Tutoring System
10. There is no significant difference between Boys and Girls in the scores of Grade2 Braille Contractions before and after introduction of Tech Aided Grade2 Braille Tutoring System
11. There is no significant difference among different Grades in Grade2 Braille Contractions before and after intervention introduction of Tech Aided Grade2 Braille Tutoring System

VII. METHOD

The method of this study has two stages

Stage I

Develop Tech Aided Grade2 Braille Contractions

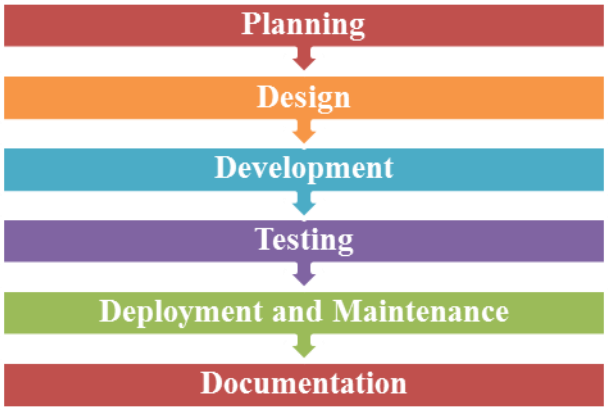
Stage II

Study the effectiveness of Tech Aided Grade2 Braille Contractions by introducing it to the students with visual impairment.

i. Stage I: A. Developing a tech aided Grade2 Braille Tutoring System

The process of development of tech aided Grade2 Braille tutoring system involves the following

a. Life Cycle of Tech Aided Grade2 Braille (TAG2B) Software Development



Lifecycle of TAG2B works in an iterative process. Iterative process breaks down the development of software into smaller units from the larger one. Here, the feature code was designed, implemented and verified in repeated process. For each iterations, new features have been added to design, implement and tested. Once the entire software is ready with the entire functionality, the software is ready to release in the user environment. The TAG2B software works in three builds and each build has the following phases. They include requirement gathering, design, development, verification, and finally deployment.

1. Planning-requirement Gathering

Requirement gathering is the planning phase of TAG2B software development. In other words, the core requirements of the TAG2B software were established. The development committee arranged meeting with its client and end user to gather the requirement about the functionality of the software. This helped to frame functional and nonfunctional requirements of the software. The committee prepared a checklist which contains

- TAG2B's scope and objective
- Functional and non-functional requirements of TAG2B
- Estimated time involved to complete TAG2B
- Estimated cost involved in TAG2B
- Estimated manpower involved for developing TAG2B
- Estimated bugs and defect occur based on similar projects of TAG2B
- Tools required

Spending more time in requirement gathering leads to minimize the development time period and testing time period. The entire requirement gathering of TAG2B was analyzed in the beginning. The time taken for requirement gathering was 4 months.

2. Design

Design stands for blueprint of prototype of TAG2B software. Based on the requirement of TAG2B, various diagrams like end product of tool, object oriented diagram, static and behaviour diagrams of UML etc., were created. Attributes, methods and their relationships were identified. Based on this, the development team developed the software. Hence the output of the former phase is the input of the later phase. Design phase reduced the complexity of developing the TAG2B software.

As mentioned above, there are three builds in developing TAG2B. Design of developing alphabet of Braille comes in build 1. This happened in the 4th month of lifecycle of TAG2B development. Design of developing first 5 contractions was done in build 2 which happened in the 7th month of TAG2B lifecycle. Last 6 contractions were designed in the 11th month of the TAG2B lifecycle.

- Prototype
- UML diagrams
- Module design
- Attributes, methods, and its relationships

3. Development

From the name, it is understood that the development means implementation of TAG2B software. The entire TAG2B project was divided into smaller units. Each unit was developed in separate build-ups. Based on the framework of design, alphabet of Braille was implemented in build 1 which took 4^{th} month of the TAG2B lifecycle. In 8^{th} and 9^{th} month of TAG2B lifecycle, first 5 contractions were developed in build 2. From 12^{th} to 14^{th} month of TAG2B lifecycle, last 6 contractions were developed in build 3.

- Implementing build 1, 2 and 3 using Visual Basic 6.0

4. Verification

Verification implies 'Ám I developing the TAG2B software right?'. Validation means 'Ám I developing the right TAG2B software?'. It is nothing but testing the software during each build-ups. Once the smaller unit of the software is developed, it is necessary to verify the software whether it works perfectly or not. 6^{th} month duration was taken for verifying the piece of software of build, 10^{th} month for software in build 2. Finally the entire unit of TAG2B software was tested in 15^{th} month of lifecycle of TAG2B development.

- Verification and validation

5. Deployment

Deployment means delivering the TAG2B software to the client. The client will release the software in the user environment and receives the acknowledgement from the end user. The acknowledgement may either be positive or negative. Based on the acknowledgement the TAG2B software may be modified. Deployment was taken in 16^{th} month of lifecycle of TAG2B development.

- Usage of TAG2B software
- Customer satisfactory
- Maintenance

6. Documentation

Documentation means converting entire TAG2B software into words and pictures. It is a user manual to guide the user how to operate the TAG2B software. It describes the step by step working process of the software. This helps for the layman to understand the TAG2B tool and to use it. 17^{th} month was taken for documentation in lifecycle of TAG2B development.

- User manual

b. Module description of Tech Aided Grade2 Braille Contractions

A rule-based expert system for Grade2 Braille contractions was designed as follows:

i. Description of Grade1 and Grade2 Braille

Braille is a method of touch reading / writing created by Louis Braille for visually impaired persons. The alphabetical letters are represented via raised dots. Braille alphabets are represented using cells. There are totally 6 cells which will set forth in three rows and two columns. The combination of cells is different from one alphabet to another. In traditional method, Braille is embossed in a paper. Modern technologies are developed to create a platform for visually impaired students with refreshable Braille display, voice over system etc. Thus, the proposed system helps to learn the Braille using voice over system.

Alphabet stands for English alphabet. They are 26 in numbers. Contraction is the shortest way of writing the Braille that helps the Braille user to read and write faster. Also, it occupies less space while printing. They are normally called as Grade2 Braille. Uncontracted Braille includes letters, numbers and punctuation mark which is called as Grade 1 Braille.

Contractions Category

Contractions overcome the problem of bulk volume of Braille books. Also, it reduces the cost of paper. Contractions have the categories such as Alphabet word signs, Strong word, Lower word Dot 5 initial letter, Dot 4-5 initial letter, Dot 4-5-6 initial letter, Final letter, Short form words, Indicators, Punctuation and Grouping punctuation. TAG2B software helps the visually impaired to learn and practice Braille codes based on these categories.

S.No	Grade 1 & 2 Braille Contractions	Number
1.	Alphabet	26
2.	Alphabet Whole word contractions	23
3.	Special word signs	06
4.	Simple upper group signs & Word signs	11
5.	Lower Group signs	10
6.	Punctuation	17
7	Compound Signs-Initial Word signs With Dot 5	22
8.	Initial Word signs With Dot 4 5	05
9	Initial Word signs With Dot 4 5 6	06
10	Final group signs	12
11	Composite punctuation signs	08
12	Short forms	75
13	Indicators	25
	Total	246

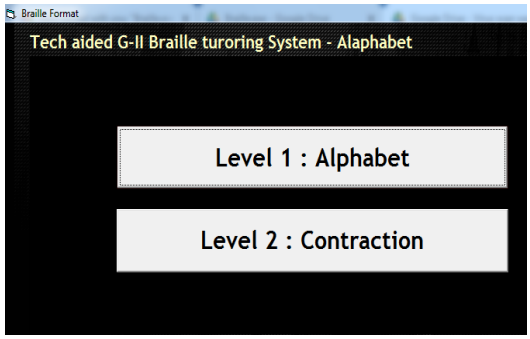
Description of Tech Aided Grade1 and Grade2 Braille

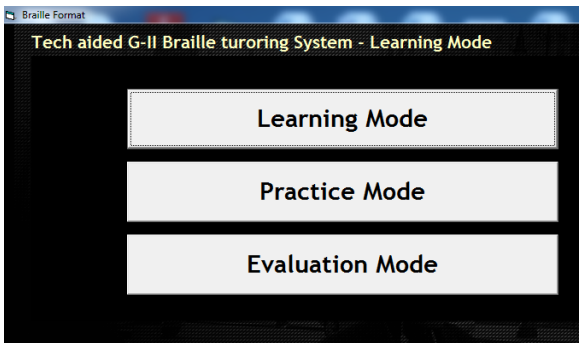
TAG2B software is divided into two major modules namely Alphabet and Contractions. Each of these modules have three sub modules. These sub modules are developed in three build-ups such as learning, practice and contraction and combined together at the end. This helps the

software to be a single entity. The module diagram for TAG2B software development is shown in the following figure.

Module description of TAG2B

1. Execution Window





2. Keys Used

The QWERTY key of existing computer key board has been converted to Braille keys by downloading Duxbury software. As such, the keys of FDS and JKL are used for the six keys of the Braille. The below table explains the keys and the corresponding Braille cells. The keys used for operations in TAG2B software.

S.N	Keys Used	Operation	
1	F	Selecting Cell 1	
2	D	Selecting Cell 2	
3	S	Selecting Cell 3	
4	J	Selecting Cell 4	
5	K	Selecting Cell 5	
6	L	Selecting Cell 6	
7	Upper Arrow	User to point the option	
8	Down Arrow	User to point the next option	
9	Shift	Selecting the current pointed option. SHIFT key instead of ENTER key	
10	Esc	Go Back to the previous window	

The visually impaired students must learn the key used before getting into the tool. The investigator gives instruction about the key used to visually impaired students. To map or select the cell 1, the visually impaired student has to enter the key F then to press SHIFT key. Thus, the cell 1 is selected. Mapping to cell 1 indicates the alphabet A. To map 1-2-4, the visually impaired student has to give the input as FDJ simultaneously and to press SHIFT key. 1-2-4 cells represent the alphabet F. The same procedure is repeated for all the alphabet and contractions with their corresponding cell values.

3. Time Complexity

Time complexity is the amount of time taken by the system to perform its operations. Time complexity is also referred to computational complexity. It is determined by counting the number of operations involved in the program. TAG2B software works well for all the three cases. Table shows the time complexity with respect to O (i.e,.big-o) notation.

Time complexity of the proposed system

S.No	Complexity case	Time complexity
1	Best case	O(n log n)
2	Average case	O(n log n)
3	Worst case	O(n log n)

c. Pilot Study

Pilot study was conducted among 10 students with visual impairment. The sample selected was from inclusive schools in Coimbatore district. Pre-test and Post test was conducted. Adequate modifications in the tool were made after Pilot study.

ii. Stage II: Effect of Tech Aided Braille Tutoring System

The newly developed Braille Tutoring System is to make the students with visual impairment learn Grade2 Braille Contractions. The effect of Tech Aided Braille Tutoring System was experimented with the visually impaired student's participation and performance in Tech Aided Grade2 Contractions. For this purpose, samples were selected and the procedure for finding out the effectiveness of the Tech aided Braille Tutoring System is given below.

a. Selection of the Sample

The sample comprised of 42 students with visual impairment (boys-22; girls-20) from Grade VIII to XII studying in 26 Higher Secondary Schools in Coimbatore District of Tamil Nadu

b. Design of the Study

Stratified random sampling technique was adopted to select the sample. The design adopted in the study is Quasi Experimental Design. It is a Single Group Design. Pre observations/ test and Post observations/ test were made besides Treatment. The layout of the design is $O_1 \times O_2$. Here O_1 is Pre observation, O_2 is Post observation and × is Treatment in this experimental study.

c. Variables

The **variables** selected in the study

1. **Independent Variable**
   a. Newly developed Tech Aided Grade2 Braille Tutoring System
   b. Gender : Boys and Girls
   c. Grade : VIII, IX and X (Group I)
      IX and XII (Group II)
2. **Dependent Variables**
   i. Rating of features of the newly developed Tech Aided Grade2 Braille Tutoring System
   ii. Assessment of Performance of Students with Visual Impairment in using Tech Aided Grade2 Braille Tutoring System with respect to 8 contraction modules developed

d. Construction of the Tool

1. Personal Data Bank

To collect general information regarding Gender, Grade and Name of the School Personal data bank was developed.

2. Tool to assess the level of acquisition of Braille Concepts

This involves 26 items in Manual Braille related to Braille alphabet to know the acquisition of Braille skills.

3. Assessment of Performance of Grade2 Braille Contractions

The test was aimed to measure the performance of students with visual impairment on Braille contractions. Two hundred and twenty Grade2 Braille contractions were included from the new edition of the Braille Primer (1955) which offers a complete course in Grade2 standard English Braille.

Scoring: For each correct response one score and zero score for incorrect response.

4. Measuring internal Consistency of Tool

A questionnaire related to measure the internal consistency of Tech Aided Grade2 Braille Tutoring System was developed. It is in the form of 4 point rating scale viz Strongly Agree, Agree, Disagree and Strongly Disagree.

e. Intervention Strategies

After conduct of pretest using the Manual Braille developed, training regarding the Braille Alphabet and Grade2 Braille contractions were given in sessions. A demonstration was given on Tech Aided Grade2 Braille Tutoring System which has voice over with minimal Computer key usage. Then the students with visual impairment were given intervention & training on the application of Tech Aided Tutoring System with the help of three applications viz.. Learning Mode, Practice Mode and Evaluation Mode.

The students were then oriented through **Tech aided Grade2 Braille Tutoring System.**

Learning Mode

The student with visual impairment were taught and familiarized with Braille Grade1 & Grade2 contractions. The Computer Programme is set up as an individualized Unit for each student participant. The Braille alphabet were introduced one by one in a sequence with the possibility of listening to the instructions for typing the letter cell corresponding to the required Alphabet and Braille contractions. The Braille cell will be automatically displayed on the screen.

Practising Mode

In this Phase, the students with visual impairment were trained to practise Braille Alphabet and Braille Contraction. The Computer Programme is set up as an individualized unit for each student participant. The Braille Contractions can be typed in the computer and practised for better understanding and learning. The students can practise the entire Braille contractions. The students were exposed to this phase for a duration of six months to get a better practice regarding Braille contractions.

Evaluation Mode

In this Phase, the students with visual impairment are evaluated to know the performance level of students regarding Braille contractions and Braille alphabet. The Computer Programme is set up as an individualized unit for each student participant. In this phase the computer is programmed to display the word contractions and the student types the dots required. Once the dots are typed the student with visual impairment can self evaluate their performance.

f. Data Collection Procedure

Phase I

An assessment was made on Grade2 Contractions using Manual Braille.

This test was considered as pretest using Manual Braille sheet. The time duration taken for assessment of performance was one month.

Phase II

An assessment was made on Grade2 Contractions after intervention. This test was considered as post test.

This test was considered as performance using tech aided Grade2 Braille contractions. The time duration taken for assessment of performance was one month.

VIII. MAJOR FINDINGS OF THE STUDY

1. The Repeated Measures ANOVA for Alphabet Word sign revealed that there is a significant improvement in the pre and post means (Pre Mean: 1.5; Post Mean 17.71). The timeline analysis of the score for the same Alphabet word sign revealed that during Learning and Practice, the mean is 6.7 and it is increased to 10.45 in the 1st evaluation followed by 13.33 in the 2^{nd} evaluation and in the 3^{rd} evaluation the mean is 15.38 and the final score in the posttest is 17.71 indicating the efficacious of newly developed Tech Aided Grade2 Braille Tutoring System on Learning Grade2 Braille.
2. The analysis for Strong Word Signs revealed that there is improvement from pretest, intermittent test and posttest. The scores : Pre mean (M =0.93); 1st evaluation (M=7.71); 2nd evaluation (M=10.07); 3rd evaluation (M=11.98) and Post mean (M=13.48)

3. The analysis for Lower Signs revealed that there is improvement from pretest, intermittent test and posttest. The score : Pre mean (M = 0.29); 1st evaluation (M=3.62); 2nd evaluation (M=4.83); 3rd evaluation (M=6.07) and Post mean (M=7.40)
4. The analysis for Dot-5 Initial Letter revealed that there is improvement from pretest, intermittent test and posttest. The score : Pre mean (M =0.86); 1st evaluation (M=8.67); 2nd evaluation (M=11.33); 3rd evaluation (M=13.55) and Post mean (M=16.07)
5. The analysis for Dot 4, 5 and 6 Initial Letters revealed that there is improvement from pretest, intermittent test and posttest. The score: Pre mean (M=0.21); 1st evaluation (M=1.07); 2nd evaluation (M=1.93); 3rd evaluation (M=2.83) and Post mean (M=3.64)
6. The analysis for Final Letter Contractions revealed that there is improvement from pretest, intermittent test and posttest. The score: Pre mean (M =0.00); 1st evaluation (M=3.90); 2nd evaluation (M=5.60); 3rd evaluation (M=7.24) and Post mean (M=8.98)
7. The analysis for Short Forms revealed that there is improvement from pretest, intermittent test and posttest. The score: Pre mean (M=2.64); 1st evaluation (M=27.71); 2nd evaluation (M=39.33); 3rd evaluation (M=48.02) and Post mean (M=57.98
8. The analysis for Dot 4 and 5 Initial Letters revealed that there is improvement from pretest, intermittent test and posttest. The score : Pre mean (M =0.19); 1st evaluation (M= 1.48); 2nd evaluation (M=2.17); 3rd evaluation (M=2.81) and Post mean (M=3.45)
9. The study reveals that there is a no significant difference between Boys and Girls in performing in Alphabet Word Sign, Strong Word Signs, Lower Signs, Dot5 Initial Letter, Dot 4 and 5 Initial Letter, Dot 4, 5 and 6 Initial Letter, Final Letter Contractions, Short Forms. Hence gender seems to be independent of its own.
10. The study reveals that there is a no significant difference among VIII to XII students in performing in Alphabet Word Sign, Strong Word Signs, Lower Signs, Dot 5 Initial Letter, Dot 4 and 5 Initial Letter, Dot 4,5 and 6 Initial Letter, Final Letter Contractions, Short Forms. Hence grade seems to be independent of its own.

IX. SCOPE OF THE STUDY

It is universally designed tech aided Grade2 Braille Tutoring System

It has three modes-Learning, Practice and Evaluation which is a self learning tool.

It can be learnt in offline mode

It is self-evaluator as well as teacher evaluator tool.

X. DELIMINATION

1. The present investigation being an Experimental study was confined to 42 samples.
2. The study was confined to Coimbatore district in Tamil Nadu.
3. The study was confined to students with total vision impairment.

XI. CONCLUSION

The Tech Aided Grade2 Braille tutor helps students with visual impairment and induces their performance in Braille literacy. The study stands testimony to it.

REFERENCES

1. Peaco, F. L (2004). Braille Literacy: Resources for Instruction, Writing Equipment, and Supplies. NLS Reference Circulars. In *Library of Congress*. Library of Congress. 101 Independence Ave SE, Washington, DC 20540.
2. Shahbaz Ali Khidri and et. al (2014), Blind Aid: A Self-Learning Braille System for Visually Impaired International Journal of Engineering Research and General Science Volume 2, Issue 4, ISSN 2091-2730 641.
3. Simalalo, M (2006). Assessing the expanded core curriculum for learners with visual impairments in special schools. *Unpublished PhD Thesis. University of South Africa*.
4. Vaca, D., Jácome, C., Saeteros, M., & Caiza, G. (2018). Braille grade 1 learning and monitoring system. In *2018 IEEE 2nd Colombian Conference on Robotics and Automation (CCRA)* (pp. 1-5). IEEE.
5. Vaca, D., Jacome, C., Saeteros, M., & Caiza, G. (2018). Braille Grade 1 Learning and Monitoring System. In L. Garcia, P. Wightman, W. Percybrooks, H. Carrillo, & C. Quintero (Eds.), *2018 IEEE 2nd Colombian Conference on Robotics and Automation, CCRA 2018* [8588144] (2018 IEEE 2nd Colombian Conference on Robotics and Automation, CCRA 2018). Institute of Electrical and Electronics Engineers Inc.. https://doi.org/10.1109/CCRA.2018.8588144.
6. Johnson and L., (1996) "The Braille Literacy Crisis for Children", Journal of Visual Impairment & Blindness, v90, n3, p276-78, ISSN: 0145-482X
7. Spungin and S. J.,(1996) "Braille and Beyond: Braille literacy in a Larger Context", Journal of Visual Impairment & Blindness, v90, n3, p271-74, ISSN
8. Jimenez Javierand et.al(2009), "Biography of Louis Braille and Invention of the Braille Alphabet", Survey of Ophthalmology, v54, n1, p142-49
9. Kazmi Hasan and Noman Siddiqui, "Status of Children in Blind Schools in the Northern Areas of Pakistan", J. Ayub Med. Coll. Abbottabad, v19, n4, p37-39, 2007.
10. https://nfb.org/images/nfb/publications/fr/fr32/1/fr320103.htm